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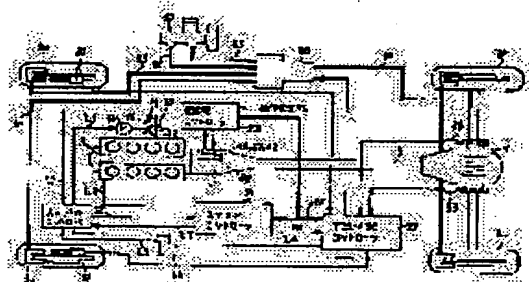
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(54) DRIVING FORCE CONTROLLER FOR VEHICLE

(57)Abstract:

PROBLEM TO BE SOLVED: To finely and properly switch the control laying stress on the speed change responsiveness and the accelerating performance, and the control laying stress on the stability, by controlling the speed change time to be taken long at the acceleration slip in a manual range mode of a transmission which can select the manual speed change in addition to the automatic speed change.

SOLUTION: In an A/T controller 23 for controlling an automatic transmission 4, the mode can be selected and switched from a shift operation device which can select a M mode in addition to an automatic speed change mode, and the speed change is executed under a condition that a shift time is shortened in comparison with the ordinary range to improve the accelerating performance in the speed change by the M mode selection. On the other hand, the speed change is controlled under a condition that the shift fastening time is longer than the basic set shift fastening time in the M mode, in the output control for throttling a throttle valve 12 of an internal combustion engine 3 for the slip control, that is, in a TCS operation by a TCS control system. Whereby the slip generation by the change of the driving torque, is relieved and prevented to effectively inhibit the same.



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CLAIMS

[Claim(s)]

[Claim 1] The driving force control unit for vehicles characterized by providing the following. A means to detect a slip of the driving wheel of vehicles A means to detect an acceleration slip state based on a slip of a driving wheel An internal combustion engine output-control means to control the output of an internal combustion engine to carry out inhibitory control of this driving wheel torque at the time of an acceleration slip The change gear which has the manual range mode set as the 2nd gear change time which shortened the gear change time at the time of this selection to the 1st gear change time [in / a usual range / the gear change in hand control besides automatic gear change is selectable, and], and a means to control to lengthen gear change time at the time of an acceleration slip with this manual range mode

[Claim 2] The driving force control unit for vehicles characterized by what a calculation means by which the aforementioned slip detection means computes the slip state between a tire/road surface from the rotational frequency of a coupled driving wheel and the rotational frequency of a driving wheel which are detected by means to detect the rotational frequency of a coupled driving wheel, means to detect the rotational frequency of a driving wheel, and these meanses is included for.

[Claim 3] The driving force control unit for vehicles according to claim 1 or 2 characterized by what gear change time is set up for according to a road surface μ in the gear change time control at the time of an acceleration slip with the aforementioned manual range mode so that it may become so short that a road surface μ is high.

[Claim 4] It is the driving force control unit for vehicles characterized by what is controlled in the direction in which a shift up becomes is easy to be performed in an accelerator quantity opening side to a shift schedule set to either a claim 1 or the claim 3, and usual to the time of an acceleration slip in the aforementioned change gear.

[Claim 5] It is the driving force control unit for vehicles characterized by what is controlled in the direction in which a shift up becomes is hard to be performed in an accelerator low opening side to a shift schedule set to either a claim 1 or the claim 4, and usual to the time of an acceleration slip in the aforementioned change gear.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] this invention relates to the control unit for vehicles, especially the driving force control unit for vehicles.

[0002]

[Description of the Prior Art] The change gear which has the manual gear change mode (M mode) in which gear change is directed based on the manual (manual) operation of automatic gear change mode and a driver made based on the run state of vehicles (automobile) is known (for example, JP,5-322022,A (reference 1)).

[0003]

[Problem(s) to be Solved by the Invention] This seed M mode function is in the inclination introduced as what raises the correspondence nature of a driver more. In the automatic transmission which has such a function, a driver can perform gear change by manual operation, when acceleration is desired.

[0004] On the other hand, there is TCS (traction control system) as control at the time of acceleration as a control system which is going to suppress a slip (acceleration slip). TCS can perform this as what is depended on the internal combustion engine output control which carries out inhibitory control of driving wheel torque for example, at the time of an acceleration slip.

[0005] here — for example, the following points can be pointed out if it is based on consideration of this invention person when the control system and the above-mentioned automatic transmission of this TCS function are introduced and carried at vehicles

[0006] (b) Drawing 6 is drawing referred to also at explanation in the after-mentioned this invention example. Drawing has shown the up shifting of the 1st speed (1st) → 2nd speed (2nd), and transition of the driving wheel torque in the gear change.

(b) If shift time (gear change time) is short set up at the time of 1→2 up shifting in manual gear change instructions, it can consider as control of acceleration nature serious consideration.

[0007] (c) If shift conclusion time is short here, driving wheel torque will serve as a wave like solid line illustration here to the case where it is shown in an alternate long and short dash line. Fundamentally, the field of a shift shock becomes the part and considering as a sacrifice a certain grade. That is, even though there is a fall of the feeling of a feeling which will serve as a thing for gear change in this case given to a driver as shocking (a driver receives) However, if the vehicles operation scene at this time, therefore such instruction operation are considered on the other hand including the actually taken intention of a driver The intention of the driver wished that up shifting is carried out and it accelerates [make / ** / it] by manual gear change, without being based on automatic gear change can be made reflected more with this mode that compared with a usual range (alternate long and short dash line), and shortened shift conclusion time (solid line).

[0008] (d) Therefore, when thinking acceleration nature as important, it can say that the thing of the above-mentioned (b) and a (c) can respond to this, and it is this point and the above-mentioned shortening will become useful.

[0009] if time which gear change takes as much as possible tends to be shortened in (**) and

time for the reason on such an acceleration disposition, surplus torque (shift shock) like illustration tends to induce a slip (drive slip) at the time of gear change — it is a situation a next door and a case, and this affects stability and affects the efficiency nature of the TCS performance under operation simultaneously

[0010] (Passing) A dashed line expresses a road surface grip limitation among a view. this means the required driving force (driving wheel torque) corresponding to the road surface μ (road surface coefficient of friction), bends idling (wheel spin) as much as possible in the control-system side of the above-mentioned TCS function, and seems to become like and the required driving torque which balanced the grip of a road surface such — ** — the output control (TCS control) is performed

[0011] In a (g), however the scene where the mode of the above acceleration nature serious consideration is used by the driver If the amount of [by shift conclusion time being short] above-mentioned surplus torque becomes what surpasses the level of a dashed line greatly as the slash in drawing was attached during the gear change in the manual gear change instructions (inertia phase) In the meantime, it becomes easy to produce this as what depends the road surface grip limitation in the scene concerned on a part for the driving torque which surpassed greatly (a part for torque change).

[0012] (h) Therefore, like the above-mentioned (e) — a (g), the amount of [which also saw the control scene on which TCS operates simultaneously from the road surface grip limitation by the TCS function / of torque] surplus becomes becoming an inclination used as a big thing, and it causes generating of the slip by it a result and in the meantime. the shift up according [desirable one] to manual operator command is also such — a slip — making — it is making it hard to carry out and being able to be made to perform effective suppression of this On the other hand, in order for the shortening [both] shift time slightly to use the acceleration intention of a driver as a reflection ** plug as much as possible like the above-mentioned (b) — a (d), it is enabling it to also utilize the function in this field as much as possible from an effective means and an effective bird clapper, and is the thing for which the advantageous field is demonstrated effectively and which can be made to carry out things. drawing — one — → — two — up shifting — setting — a shift — conclusion — time — being short — if — being short, so that — the torque change — elutriation feeling — becoming — a result — a torque size sake — a low μ way — slip generating — the vehicles concerned of a large next door and a TCS function which have a control system — a stability degradation factor — becoming — obtaining .

[0013] more desirable one can respond also to the scene in a low μ way also according to such a road surface situation, suppresses a slip effectively, and secures improvement in stability, and the efficiency nature of a TCS performance, the coexistence which has the harmony about these acceleration nature and stability, harnessing effectively another side and the advantageous field of such an M-mode function also aims at appropriately, and the above-mentioned thing attains — — it is that control is also realizable

[0014] this invention applies, when it carries the control system by the output control of the internal combustion engine for slip suppression, and the change gear which can also perform selection of gear change with the hand control by the driver besides automatic gear change, based on the above consideration, it is going to add improvement and an improvement from these points also based on the consideration described below, and it is suitable and closes making the control which can realize the above appropriately perform, if possible.

[0015] Moreover, the control unit which can carry out fine and suitable proper use of gear change responsibility, the field of acceleration nature serious consideration, and the field of stability serious consideration will be offered.

[0016]

[Means for Solving the Problem] By this invention, the driving force control unit for vehicles is offered as following. Namely, a means by which this invention detects a slip of the driving wheel of vehicles and a means to detect an acceleration slip state based on a slip of a driving wheel, An internal combustion engine output-control means to control the output of an internal combustion engine to carry out inhibitory control of this driving wheel torque at the time of an

acceleration slip, and the gear change in hand control besides automatic gear change are selectable. The change gear which has the manual range mode set as the 2nd gear change time which shortened the gear change time at the time of this selection to the 1st gear change time in a usual range. It is characterized by having a means to control to lengthen gear change time at the time of an acceleration slip with this manual range mode.

[0017] Moreover, in the above, the aforementioned slip detection means is characterized by what a calculation means to compute the slip state between a tire/road surface from the rotational frequency of a coupled driving wheel and the rotational frequency of a driving wheel which are detected by means to detect the rotational frequency of a coupled driving wheel, means to detect the rotational frequency of a driving wheel, and these meanses is included for.

[0018] Moreover, in the gear change time control at the time of an acceleration slip with the aforementioned manual range mode, it is characterized by what gear change time is set up for according to a road surface μ so that it may become so short that a road surface μ is high.

[0019] Moreover, the aforementioned change gear is characterized by what is controlled by the accelerator quantity opening side to the usual shift schedule in the direction in which a shift up becomes is easy to be performed at the time of an acceleration slip.

[0020] Moreover, the aforementioned change gear is characterized by what is controlled by the accelerator low opening side to the usual shift schedule in the direction in which a shift up becomes is hard to be performed at the time of an acceleration slip.

[0021]

[Effect of the Invention] When it carries the control system by the output control of the internal combustion engine for slip suppression, and the change gear which can also perform selection of gear change with the hand control by the driver besides automatic gear change by the above-mentioned composition according to this invention, apply and are suitable. Set it as the 2nd gear change time which shortened gear change time to the 1st gear change time in manual range mode, and appropriately, while control of the acceleration nature serious consideration in which the intention of a driver was made to reflect is possible At the time of an acceleration slip with manual range mode, it can carry out that gear change time can be lengthened alternatively and it is hard to carry out the slip by part for driving torque change, and the effective suppression can be aimed at. Moreover, it becomes possible to carry out fine and suitable proper use of gear change responsibility, the field of acceleration nature serious consideration, and the field of stability serious consideration. As for manual range mode, an automatic transmission or a nonstep variable speed gear is contained here, as for a change gear, including two range.

[0022] Moreover, it can carry out suitably as composition including like and a calculation means to compute the slip state between a tire/road surface from the rotational frequency of a coupled driving wheel and the rotational frequency of a driving wheel at which the acceleration slip detection means is detected by means to detect the rotational frequency of a coupled driving wheel for this, means to detect the rotational frequency of a driving wheel, and these meanses according to claim 2, and the above-mentioned thing can be realized similarly.

[0023] Furthermore, if it constitutes preferably so that it may become so short that a road surface μ is high and gear change time may be set up like a claim 3 according to a road surface μ In addition to the above, can aim at improvement in gear change responsibility and acceleration nature, and a road surface μ situation is also embraced. Being able to respond also to the scene in a low μ way, suppressing a slip effectively, securing the efficiency nature of the output control of the internal combustion engine for improvement in stability, and slip suppression, and harnessing effectively another side and the advantageous field of a manual range mode function Coexistence with the harmony about these acceleration nature and stability can also be aimed at appropriately.

[0024] Moreover, this invention can be constituted so that it may be controlled in the direction in which a shift up becomes is easy to be performed in an accelerator quantity opening side to an according to claim 4 shift schedule usual [like] to the time of an acceleration slip in a change gear, it can be carried out suitably, and can realize the above-mentioned thing similarly. Moreover, this invention can be constituted so that it may be controlled in the direction in which a shift up becomes is hard to be performed in an accelerator low opening side to an according to

claim 5 shift schedule usual [like] to the time of an acceleration slip in a change gear, it can be carried out suitably, and can realize the above-mentioned thing similarly.

[0025] the time of using together both these both [either or] — a twist — the correspondence effectively doubled with the output control of the internal combustion engine for slip suppression is attained, and the efficiency nature is raised

[0026]

[Embodiments of the Invention] Hereafter, the gestalt of operation of this invention is explained based on a drawing. Drawing 1 shows the system configuration concerning one example of this invention. A right-and-left rear wheel and 3 show an internal combustion engine (engine), and, as for the inside of drawing, and 1L and 1R, the right-and-left front wheel of vehicles (automobile), and 2L and 2R show a change gear, respectively, as for 4.

[0027] In this example, it considers as the thing of the drive method with which vehicles use the right-and-left front wheels 1L and 1R as a coupled driving wheel, and use the right-and-left rear wheels 2L and 2R as a driving wheel. Moreover, let them be internal combustion engines, such as a 4-cylinder which has the ** system throttle by which electronics control is carried out, while electronics control of the engine 3 is carried out in fuel supply, ignition timing, etc.

[0028] Moreover, let be the automatic transmission (A/T) of the owner stage here, for example about the change gear 4 into which power is inputted from an engine output shaft (four-step gear change etc.). Furthermore, this shall have the automatic gear change mode in which selection of a gear ratio is made according to a gear change control parameter, and the M mode (manual range mode) to which a driver can change gears by manual operation.

[0029] Moreover, suppression of an acceleration slip (wheel spin) of driving wheels 2L and 2R or TCS control of prevention shall not be based on brake-force control, but shall be based on an engine output control (torque down) here. This control shall be based on either of the control functions (control gestalt) in which a degree and/or fall of engine outputs, such as for example, throttle control, fuel-cut (fuel cut; F/C) control, ignition-timing retard control, and charge pressure control, are possible, or shall be based on two or more combination of these control. Here, a ** system throttle and F/C are used.

[0030] In drawing, as for the engine inhalation-of-air system 10, the 1st throttle valve 11 and its opening and closing have with an actuator the 2nd throttle valve 12 (** system throttle valve) in which electronics control is possible. The throttle actuator which controls opening and closing of the ** system throttle valve 12, and carries out adjustment of an engine inhalation air content and control, and its control system contain the throttle motor 14 by which drive control is carried out with a control signal (line L1). By this, this motor 14 can be driven, the rotation can be told to this throttle valve 12 through a slowdown gear mechanism etc., and this can be made to open and close. The signal (the 2nd throttle sensor value) from the throttle sensor 16 which detects the opening (real TVO) of a throttle valve 12 can be used as feedback information by the throttle actuator control system as a throttle motor control signal (line L2).

[0031] ** system throttle equipment — setting — auto-cruise and the preceding car — if it is the case where vehicles control of flattery run control etc. is also incorporated and introduced, it can use also for controlling the opening of the ** system throttle valve 12 carrying out engine output adjustment at the time of this vehicles control execution so that vehicles may be accelerated automatically, and so that it may be made to slow down automatically. When it corresponds with this at the time of TCS control execution, it is not based on the 1st throttle-valve opening degree (for example, throttle 10 full-open state) by accelerator ** dull treading in (for example, accelerator full open) of the driver at the time of acceleration. the ** system throttle valve 12 is extracted (a throttle 12 close-by-pass-bulb-completely state is included) — it needs — TCS control by throttle control can be performed by controlling the throttle motor 14 and decreasing an engine torque (inhalation air-content down)

[0032] F/C of an engine 3 performs TCS control again. F/C control can control an engine output to also consider the number control of cylinders and to reduce an engine torque.

[0033] The output torque of an engine 3 is transmitted to driving wheels 2L and 2R through an automatic transmission 4. It can be made to run vehicles by an automatic transmission 4 changing gears by the gear ratio according to the selection gear ratio, transmitting the engine

rotational-motion force to the change gear output shaft 5 including the time of M mode, telling it to driving wheels 2L and 2R through a differential gear 6, and driving this.

[0034] this example of a system — a control unit — ** — it shall carry out, and the controller 21 for engine control of fuel-supply control etc. (ECCS C/U) shall be separately equipped with the controller (throttle control unit (C/U)) 20 which has a throttle control function as shown in drawing, and it shall have the controller 22 for the TCS control by throttle control and F/C control, and the controller (A/TC/U) 23 for automatic-transmission control. In addition, the brake system of vehicles consists of examples of illustration including the fluid-pressure control actuator 60 infixed between the brake fluid-pressure paths 55 and 55 from a master cylinder 50, and each brake fluid-pressure paths 57, 58, and 59 of resulting to a wheel wheel cylinder. Moreover, an actuator 60 can be constituted so that it may be made to function as a known ABS (antiskid control) actuator. TCS control according [as what controls both the systems of TCS and ABS, although the above-mentioned controller 22 is used as the controller (TCS/ABS C/U) the object for TCS control which also has the function which sends out a ABS control signal (three channel ABS control signal) at this actuator 60, and for ABS control, replace it with this here, and] to an engine output control — it cannot be overemphasized that it can consider as composition equipped with an independent controller, either

[0035] A controller 22 (TCS controller) has the function to perform the engine output control which carries out inhibitory control of the driving wheel torque at the time of an acceleration slip, and detects and inputs the rotational speed of a coupled driving wheel and a driving wheel into this. The signal from the wheel speed sensors 31 and 32 which detect the wheel speed (wheel rotational frequency) of the right-and-left front wheels 1L and 1R here, The signal from the wheel speed sensors (wheel rotation sensor) 33 and 34 which detect the wheel speed (wheel rotational frequency) of the right-and-left rear wheels 2L and 2R is inputted, respectively, and information, such as an engine speed (line L4) and a throttle opening output (DKV) (line L5), and the information on other are inputted.

[0036] In TCS control, based on the input to the controller 22 concerned, the slip state between a tire/road surface can be computed from the rotational frequency of coupled driving wheels 1L and 1R and the rotational frequency of driving wheels 2L and 2R which were detected the predetermined TCS control period, driving wheel acceleration slip generating can be supervised and detected, and this can be performed by program processing which outputs the control signal for TCS control (control command) etc.

[0037] The TCS controller 22 is constituted including a microcomputer. An input detector, The above-mentioned slip generating detection performed by a data-processing circuit (CPU) and this data-processing circuit, The store circuit which carries out storage storing of the information on a TCS control program including the program processing for a control signal output etc., and the result of an operation and others etc. (RAM, ROM), It can constitute from an output circuit which sends out the throttle motor target opening signal (DKR) (line L6) over the throttle controller 20, the control signal for F/C control to the engine controller 21 (data transmission line 25), etc.

[0038] The 2nd throttle sensor signal (line L2) which are throttle motor target opening information (line L6), the 1st throttle opening information (line L7), and the feedback information from the throttle sensor 12 is inputted into the throttle controller 20. Here, by the controller 20, when it corresponds, while being able to perform vehicles control of auto-cruise control as stated above etc. here, with the throttle motor target opening signal from the TCS controller 22, under the feedback control to the throttle motor 14, at the time of a TCS operation, the opening of the ** system throttle valve 12 is adjusted so that it may become the desired value (control command) in TCS control, and this performs reduction control of an engine torque at it.

[0039] while inputting into the engine controller 21 the signal from the engine rotation sensor (not shown) which detects an engine speed Ne, and the opening information on an accelerator pedal (not shown) as an engine operation parameter — the [the F/C control command (data transmission line 25) from the TCS controller 22, and] — information required for the engine operation of 2 throttle opening information (line L8) and others is inputted

[0040] These controllers 20 and 21 are similarly constituted using a microcomputer. In the case

of the engine controller 21, an input detector and a data-processing circuit (CPU), The store circuit which carries out storage storing of the various control programs for engine control, such as fuel-supply control performed by this data-processing circuit and ignition-timing control, the information on the result of an operation and others, etc. (RAM, ROM), It can constitute from an output circuit which sends out control signals, such as an injector driving signal (line L3) to a fuel injection valve, and the 1st throttle opening information (line L8) over the throttle controller 20. [0041] Further, although the engine controller 21 performs fuel-injection control carried out to a fuel injection valve to perform fuel supply so that mpg, an exhaust gas property, etc. may become the optimal based on an engine speed, load information, etc., and it performs engine control of ignition-timing control and others, when it corresponds at the time of a TCS operation, in addition to ** system throttle control, it performs F/C control for TCS control, and controls the driving torque of an engine 3 by the F/C control command from the TCS controller 22. Fundamentally, TCS control using throttle control and F/C control can be performed as follows, for example. The timing chart of the TCS control concerning drawing 2 is illustrated.

[0042] [The example of TCS control]

** Based on the signal from the wheel speed sensors 31-34, compare the average wheel speed (front-wheel average rotational speed) and driving wheel wheel speed (rear wheel rotational speed) of a coupled driving wheel, and detect generating of a slip (wheel spin) of a driving wheel (controller 22 (drawing 4 step S101)).

[0043] ** If a driver breaks in accelerator ** DARU (acceleration start), a driving wheel slips and the wheel speed of a driving wheel surpasses a control-point-setting value (TCS control start), while performing F/C of an engine 3, extract the ** system throttle valve 12 and decrease an engine torque (controllers 20, 21, and 22 (this step S105)). In this way, the driving torque of a driving wheel can be suppressed and the amount of slips (the amount of wheel spin) can be decreased.

[0044] ** In addition to above **, further, according to a slip of a driving wheel, F/C control and ** system throttle control can be continued, driving torque can be decreased, and the amount of slips can be decreased (controllers 20, 21, and 22 (this step S105)). Stopping the amount of slips after that, according to accelerator ** dull operation of a driver, ** system throttle control can be performed so that the acceleration according to the road surface state may be obtained.

[0045] Like ****, the rotational frequency of the front wheels 1L and 1R of a coupled driving wheel and the rear wheels 2L and 2R of a driving wheel is detected. A slip state is detected from the coupled driving wheel rotational frequency information and driving wheel rotational frequency information by which **** detection was carried out. The TCS control system (engine output-control equipment) which can perform the output control of an engine 3 according to a slip state so that inhibitory control of the driving wheel torque may be carried out at the time of an acceleration slip It is constituted including the wheel speed sensors 31-34, the throttle controller 20, the engine controller 21, and the TCS controller 22 of drawing 1 . In this example, still more synthetic and integration-control between the control to the automatic transmission 4 with M mode is performed by such TCS control system. Here, a TCS control system is connected to the A/T controller 23 possible [communication]. The control information between these engine controller 21, the TCS controller 22, and the A/T controller 23 (an engine and A/T (TCS/ABS) synthesis control signal) shall communicate through the data transmission line 25 (multiplex communication).

[0046] An automatic transmission 4 has control-valve 4a besides each friction element, such as a torque converter (hydraulic coupling) inserted in the transmission system, a gear change mechanism, and a clutch brake. while a gear change control hydraulic circuit is formed in this control-valve 4a — the [the line pressure solenoid 40, the 1st shift solenoid 41, and] — it has the solenoid of 2 shift solenoid 42 and others These solenoids 40-42 are controlled by the A/T controller 23, and they input information, such as slip generating about a TCS control operation, into this controller 23 while they input the accelerator pedal opening Ap and the vehicle speed VSP information as a gear change control parameter. Here, you may make it incorporate accelerator pedal opening and vehicle speed information here from a TCS control system through the data transmission line 25, and they may input the signal from an accelerator pedal

opening detection sensor and a vehicle speed sensor, respectively.

[0047] Moreover, each information on a gear change directions (instructions) signal that gear change by the mode selection change from the shift operating set 45 which can also perform selection of M mode besides the automatic gear change mode in which selection of a gear ratio is made according to a gear change control parameter, and the manual shift at the time of M mode selection is made to perform is also inputted into the A/T controller 23. This may be the thing of the reference 1 aforementioned publication for example. The example is shown in drawing 3.

[0048] In the case of drawing 3, like illustration, an operating set 45 meets one shift-lever guide slot 45a, and each range position is set up in order of [this] parking (P), reverse (R), a neutral (N), and a drive (D). Moreover, the up shifting position (+) and down shifting position (-) of the manual shift sake chosen by moving a shift lever (not shown) horizontally from a D-range position, and making it move forward and backward as a thing for M mode are set as guide slot 45b parallel to this. Thereby, at the time of the M mode selection by the driver, if a shift lever is pushed down forward and backward within guide slot 45b while an M mode selection signal is outputted, an up shifting signal and a down shifting signal will be outputted each time. Therefore, the directions to the gear ratio by the side of one-step high speed or an one-step low speed can carry out to a controller 23, and if it has the M mode function which can perform selection of up shifting and down shifting in such manual operation, a driver can perform gear change according to the intention of self [the M mode], without being based on the gear ratio (change gear ratio) control by the automatic gear change by the D range.

[0049] The A/T controller 23 is constituted including a microcomputer. The input detector for the input which also contained the data from a TCS control system here, The gear change control performed by a data-processing circuit (CPU) and this data-processing circuit, Others [programs / fundamental /, such as lock-up control by the torque converter, and line pressure control, / gear change mechanism], The store circuit which carries out storage storing of the information on various control programs, such as the time of communications control with a TCS control system, and M mode selection, and/or TCS operation correspondence control, and the result of an operation and others etc. (RAM, ROM), It can constitute from an output circuit which sends out the control signal for a drive to the solenoid 40 of control-valve 4a - 42 grades.

[0050] Fundamentally about gear change, this can be performed as a thing of the following contents of control. An automatic transmission 4 has the shift schedule which performs gear change control by accelerator ** dull opening and the vehicle speed. On the occasion of gear change control, in the time of D-range selection (automatic gear change mode), the A/T controller 23 chooses the optimal gear ratio for the present operational status from these information according to the shift schedule defined beforehand, makes the shift solenoids 41 and 42 turn on and turn off, and performs predetermined gear change so that it may become the gear ratio.

[0051] in the same accelerator ** dull opening A_p , carrying out [to which the vehicle speed VSP becomes high] a schedule so that it is alike, it follows, a schedule is carried out so that auto up shifting may be carried out to the upper stage, and a drive run for the present gear ratio may be so possible that the accelerator ** dull opening A_p is large as much as possible, it may come together a high vehicle speed side, it may come out and auto up shifting may be carried out usually comes out, and a shift schedule has it (for example, normal shift schedule And in automatic gear change, the gear change line property data (shift schedule data) beforehand set up as a function of this accelerator pedal opening A_p and vehicle speed VSP can be used, the A/T controller 23 can judge and determine the optimal gear ratio based on the present accelerator pedal opening A_p and the present vehicle speed VSP signal of the vehicles [concerned] on stream, and it can carry out by ordering it ON of the shift solenoids 41 and 42, and the combination of OFF so that this gear ratio may be acquired. In this case, control-valve 4a can supply the line pressure whose pressure was regulated by the solenoid 40 as operation oil pressure (bonding pressure) to the friction element as which the gear change inside of a plane was chosen, and can make the above-mentioned optimal gear ratio choose it as an automatic

transmission 4 by the operation (release and conclusion) of these friction elements according to ON of the shift solenoids 41 and 42, and OFF.

[0052] If it is in the case of M mode, this can be performed according to the signal from an operating set 45. At this time, the gear ratio the A/T controller 23 was instructed to be in the manual shift by the driver is judged. And if it is ordered ON of the shift solenoids 41 and 42, and the combination of OFF so that an applicable gear ratio may be acquired, release / conclusion control of the correspondence friction element based on this can be made to perform gear change for a correspondence gear ratio.

[0053] Furthermore, in addition to the above, for the reason on an acceleration disposition, in this example, it is based on performing gear change to drawing 6 by the gear change at the time of M mode selection like instantiation as what shortened shift time (gear change time) to a usual range (D range). if shift conclusion time is compared in the case of a D range (the inside of drawing, alternate long and short dash line), and is shortened in change control of the correspondence friction element of an automatic transmission 4 by this in the case of the gear change at the time of M mode, and free running time of a before [conclusion of a conclusion side friction element] can be lessened as much as possible therefore, it can do with control of acceleration nature serious consideration like previous statement

[0054] In this case, although it is relatively long in a D range, and it is short set up to this shift conclusion time by M mode, as shown in drawing, and shift conclusion time differs in both, for example, line pressure control, therefore friction-element bonding pressure control can perform change control (selection control) of shift conclusion time. Here, by automatic gear change by the D range, it compares at the time of M mode, gear change tense line pressure is made low, and it controls by manual gear change by M mode conversely to make gear change tense line pressure higher than it. The A/T controller 23 also performs alternative gear change time control according to whether it is automatic gear change mode and whether it is the M mode which the driver has chosen in this way.

[0055] In addition, preferably, even if the A/T controller 23 accepts the conditions of being a time of the TCS operation relevance by the TCS control system, it also performs further alternative gear change time change control again so that shift conclusion time may be controlled (change) without being chiefly based only on the condition uniformly, even if it corresponds to M mode. Preferably, about this, it makes as [perform / gear change control which made shift conclusion time longer than the fundamental setting shift conclusion time in the above-mentioned M mode] at the time of the TCS operation by M mode. Thereby, similarly, slip generating by part for driving torque change which was considered by the (b) of the specification beginning - the (h) is also eased and prevented, and the effective suppression etc. is aimed at. By the ability coming, the TCS controller 22 of a TCS control system sends a control signal also to the A/T controller 23 while sending a control signal to the throttle controller 20 and the engine controller 21 with the signal from a wheel speed sensor in hard [slight].

[0056] Shift conclusion time sets this up again according to the road surface μ at the time of the TCS operation at the time of the acceleration slip by the above-mentioned M mode preferably. As for the property and an inclination, it is good to set up so that gear change responsibility and acceleration nature may be raised like Quantity μ , as conclusion time becomes short here.

[0057] The A/T controller 23 differs from a shift schedule usual in gear change control in the above preferably. It shall be made to carry out by having the shift schedule (early shift up schedule) of exclusive use of TCS control correspondence. In this case, gear change property change control (gear change line property change control) which changes a shift schedule alternatively and controls it can also be performed to make it controlled by the accelerator quantity opening side to the usual schedule in the direction in which a shift up becomes is easy to be performed. Doing in this way is based on contrast of each item in M mode and a D range as shown in the following table 1 also including the aforementioned matter (b) - a (h).

[0058]

[Table 1]

Mモード	Dレンジ
(現象)	(現象)
a1) 通常ギア固定、マニュアル操作でシフトアップ（どこでシフトアップするか分からない）	a2) オートアップシフト
b1) シフト締結時間を短くするため（シフト時間短縮化）シフトショック大 →低μ路ではスリップ大（安定性劣化要因）	b2) シフト締結時間が長いためシフトショック小 →低μ路ではスリップ小（安定性向上）
c1) 通常シフトスケジュールよりシフトが遅れるためシフトショック大 →低μ路ではスリップ大（安定性劣化要因）	c2) （TCS対応として）通常シフトスケジュールより早期シフトアップ採用のためシフトショック小 →低μ路ではスリップ小（安定性向上）

[0059] It is the case where M mode (the mode which engine brake commits with a D range is included) shortens shift conclusion time here. As shown in Table 1, also at the time of a TCS operation when shortening gear change time uniformly by M mode, TCS performances differ by the D range and M mode. Moreover, table 1 (c1) (c2) In view of the shown viewpoint, it comes and the change of the above gear change properties may serve as a useful means the point on a stable disposition. Therefore, it is good to also use the technique of starting and the A/T controller 23 also performs such gear change control dealing with TCS control with the signal from the TCS controller 22 in that case.

[0060] Preferably, in addition to this, the A/T controller 23 is replaced with this, and to the usual schedule, by the accelerator low opening side, change control of a shift schedule is performed again so that it may be controlled in the direction in which a shift up becomes is hard to be performed.

[0061] With reference to drawing 4 or subsequent ones, change control of gear change time which was mentioned above, and when shift schedule change control is also considered further, it applies, and a suitable example is explained. Drawing 4 shows an example of a control program applicable to the comprehensive control system by TCS control with this system, and A/T control. Although it consists of Steps S101-S105 by the side of a TCS operation, and Steps S110, S121, S122, S131, and S132 by the side of TCS un-operating [which does not contain Step S105] like illustration, the content of concrete control of the engine output-control processing according to the slip state by Step S105 may apply a content of control like the already described above [example's of TCS control] processing **, and ** here. In addition, Steps S121 and S122 do not TCS operate, and are cases other than M mode, and Steps S131 and S132 do not TCS operate, and they are the cases of M mode.

[0062] Step S101 judges whether it is slip (acceleration slip) generating. This judgment can be made by the TCS controller 22 side, and you may be a content like processing ** of the above [the example of TCS control]. When the answer of Step S101 is affirmation (Y), for the control processing after Step S102 side, in a negative (N) case, the control processing after Step S110 side is *****.

[0063] Although an engine output control will be performed by execution of the loop containing the above-mentioned step S105 by the TCS controller 22 side when the answer of Step S101 is affirmation, in addition to judgment of Step S101, it is judged at this time whether it is in M mode

further at Step S102. A judgment of Step S102 can be made by the A/T controller 23 side based on the signal from an operating set 45. In addition, Step S110 is also the above-mentioned step S102 and same M mode distinction step, and is made with the thing of the same content of processing. When the answer of the above-mentioned step S102 is affirmation, processing of Step S103 is chosen, and when it is negative, processing of Step S104 is chosen in this example program.

[0064] When Step S103 is performed, it is at the TCS control operation time, and is the case where the mode selection change signal shows M mode, and M mode is chosen by the intention of a driver. Step S103 is compared with the shift conclusion time fundamentally shortened and set up by the aim of acceleration nature serious consideration, and makes it the content to carry out processing which sets up shift conclusion time so that shift conclusion time may be lengthened rather than it. Processing of Step S103 is performed by the A/T controller 23 side. Here, shift conclusion time is set up from a map by the road surface μ .

[0065] In drawing 5, the related property of the shift conclusion time T and a road surface μ in this example is illustrated. In the example of illustration, about the road surface μ , the 1st predetermined value μ_1 and the 2nd predetermined value μ_2 ($\mu_1 < \mu_2$) are set up, and the 1st predetermined-time value TA (upper limit) and the 2nd predetermined-time value TB (lower limit) are set up about the shift conclusion time T. a road surface μ — the 1st small field not more than predetermined value μ_1 — as for the 2nd large field beyond predetermined value μ_2 , a road surface μ takes the long time TA, and, as for the shift conclusion time T, the shift conclusion time T takes the short time TB. And the shift conclusion time T has [a road surface μ / Quantity μ] time short in the field of $\mu_1 < \mu < \mu_2$ within the limits of between Time TA – Time TB, and according to a road surface μ , it can set low [μ] as adjustable with the property inclination of illustration so that time may become long.

[0066] When the above-mentioned shift conclusion time TA does not TCS operate here and this program is performed here in other than M mode (i.e., the loop of step S101 → S110 → S121 → S122) It can apply as shift conclusion time T set up in the step S121 concerned, therefore the longer shift conclusion time TA is applied in gear change in the scene of the run by the usual D range, and gear change control is made. It seems that for this reason, a small alternate long and short dash line shows a torque wave and the peak of protrusion change like the example of 1 → 2 up shifting of drawing 6. For a long time, a shift shock is smallness and a result and the shift conclusion time T can also do the gear change shock which a driver senses with a good thing. In addition, the normal schedule for the time set to the gear change line property of solid line illustration which was written together also in Step S104 as a shift schedule in this case as also carried out previous statement will usually be applied (Step S122), and automatic gear change will be performed according to this normal schedule **** accelerator ** dull opening Ap and vehicle speed VSP.

[0067] Moreover, the above-mentioned shift conclusion time TB is the shift conclusion time T applied as a steady-state value (the processing returned gradually till the shift conclusion time TB of this minimum is also incorporated at Step S131 at this example program) of the shift conclusion time in manual gear change, when it does not TCS operate and processing is performed in the case of M mode (i.e., the loop of step S101 → S110 → S131 → S132).

[0068] Therefore, at the time of the manual gear change by the M mode in this case, gear change control as which the gear position (gear ratio) which the short shift conclusion time TB to take was applied, and followed the intention of a driver by the manual gear change instructions is chosen can be performed (Steps S131 and S132). a result — drawing 6 — if the example of 1 → 2 up shifting compares — the time of gear change of a D range usual in the torque wave at the time of gear change by this M mode — comparing — like solid line (M mode) illustration — a protrusion — it becomes the big wave of a peak the bottom, and although it is the part and shift shocking size which shorten shift conclusion time T with Time TB, the intention of the driver concerned is reflected more like previous statement Namely, since the advantage by shortening of shift conclusion time which was considered by specification beginning (**) – (**) was acquired (acceleration nature serious consideration), and shift conclusion time was shortened to the time TA in the case of a D range at Time TB when it was gear change at the time of M mode, It can

respond on an acceleration disposition and gear change responsibility also becomes possible [having met further by the acceleration intention of the driver concerned of having risen so much, having desired acceleration and having chosen the manual shift up to the 2nd speed from the 1st speed by selection of M mode actually] (assistance of operation of a driver). moreover, the gear change shock felt in this case at the time of the manual gear change — a certain grade — there is no dissatisfaction like ** for the driver concerned which has realized the acceleration which became large, and which was desired without the field also producing an acceleration slip actually although kicked (the answer of Step S101 denying), and it will be said that so much sense of incongruity so is not produced, either

[0069] A deer is carried out, and when an acceleration slip arises in the scene of a TCS control operation in the aforementioned step S103, even if it is the case where M mode is chosen by the driver, shift conclusion time T can be made longer than the shift conclusion time TB (steady-state value) applied at the above-mentioned step S131 by processing of this step S103. If a road surface is a road surface of the like by which TCS control is performed in general to which it is easy to slide and it is therefore in a run on such a road surface in this scene to lengthen shift conclusion time T in this way here, the acceleration nature in a meaning which was described so much above puts the foundation on the idea which is not asked (acceleration nature is not asked in practice, so that a road surface μ is more small). And it is based to the idea of the equipment with which doing so again follows this invention as a result desiring manual gear change, and suppressing slip generating from which it may become the factor of stability degradation also for the driver which carried out operation of choosing M mode, and becoming by leading in the direction which make the generating hard to carry out also with carrying out the best assistance by this scene over the operation.

[0070] Namely, if shift conclusion time T is made short with Time TB at the time of the basis of acceleration nature serious consideration, uniformity, and M mode as the aforementioned (b) – a (h) also considered this On the low μ road surface on which it is easy to slide, so that TCS operates, when a changed part of the driving torque which surpasses greatly produces a road surface grip limitation at the time of gear change, as the slash in drawing 6 was attached It is possible to make shift conclusion time T into the maximum and the shift conclusion time TA by Step S103 to this appearing as a phenomenon of the part and a slip according to this example program. Therefore, since it becomes a driving torque wave as shown with the alternate long and short dash line of drawing 6 like the case of the above-mentioned usual D range in this case, the protrusion peak of the part and surplus torque can be suppressed, although it is torque size therefore, the situation where slip generating serves as size can be prevented, and the problem [like] (b1) in the case of being the example of comparison of the aforementioned Table 1 left column can also be avoided beforehand on a low μ way. From the efficiency nature being secured and a stability degradation factor being removed also in the time of TCS control, again, therefore, as mentioned above also carrying out the optimal assistance in this scene — becoming — in addition — and, as for lengthening, the shift conclusion time T, since M mode can also be alternatively performed according to the scene concerned Coexistence with this can plan without spoiling control (Steps S101–S132) of the acceleration nature serious consideration in the time of aforementioned TCS un-operating.

[0071] Moreover, if the shift conclusion time T which should be set up for a long time in Step S103 in this case based on the map by the property inclination of drawing 5 within the limits of between the values of shift conclusion time TA–TB is set up according to a road surface μ so that it may become so short that a road surface μ is high, also by the case of this shift conclusion time change control, it is more fine and improvement in gear change responsibility and acceleration nature can also be aimed at. If it carries out like this, in Quantity μ side (dry cleaning side), the value of the shift conclusion time T will be made more to the shorter thing of time value TB approach. if it is the low μ side (sentiment side) on which is uniformly good without considering as a upper limit TA, and can aim at the part and better coexistence, and it is easier to slide again, the shift conclusion time T will become long considering the time value TA as an upper limit — as (as mentioned above) Acceleration nature can be finely set up according to the road surface μ at the time of the TCS operation concerned that it has been easy to

take the longer shift conclusion time T from not being asked so that it may become a stability serious consideration side like low $[\mu]$.

[0072] While the acceleration nature serious consideration by M mode is controllable, in this way at the time of the TCS operation by M mode The slip by part for driving torque change can be made hard to carry out, and the effective suppression can be aimed at. And, being able to respond also to the scene in a low μ way, suppressing a slip effectively again also according to a road surface μ situation, securing improvement in stability, and the efficiency nature of a TCS performance, and harnessing effectively another side and the advantageous field of this M mode function Coexistence with the harmony about these acceleration nature and stability can also be aimed at appropriately.

[0073] In addition, the road surface μ information for reference of a shift conclusion time T map shall presume and obtain this, and judges it from an order ring rotation difference or a TCS control period here, for example. When the A/T controller 23 performs this judgment, the data for it can be incorporated from a TCS control system.

[0074] Step S104 makes it the content to perform processing which changes so that a shift schedule may usually be changed into a TCS correspondence schedule from the normal schedule for the time (Step S122). A shift schedule change can be made by changing the upper limit vehicle speed or its near portion of the gear change line in the normal schedule of solid line illustration into a low vehicle speed side like the TCS correspondence shift schedule of dashed line illustration, as the example in one to 2 gear change was written together in Step S104. Therefore, it is controlled by the high opening side of the accelerator ** dull opening A_p to a normal shift schedule in this case in the direction in which a shift up becomes is easy to be performed. Moreover, it shall be changed here at the TCS correspondence schedule also about the minimum vehicle speed or its near portion of the gear change line in a normal schedule. Namely, it is controlled by this field side by being changed into a high vehicle speed side like an illustration dashed line at the low opening side of the accelerator ** dull opening A_p in the direction in which a shift up becomes is hard to be performed to a normal shift schedule.

[0075] the above — in the control system by this TCS control and A/T control, when the engine output control by the basis of shift schedule change control [like] and Step S105 is performed, when a slip is generated, it is sending a signal to the A/T controller 23 by the TCS controller 22, changing the shift schedule of an automatic transmission 4, and decreasing driving torque, and a slip of driving wheels 2L and 2R is decreased by control doubled with the output control of an engine 3 in this case — if it is the example of processing [of the aforementioned [example of TCS control]] **, and ** — accelerator ** of a driver — at the time of the acceleration slip accompanying treading in to to near [dull] the full open While performing F/C of an engine 3, extract the ** system throttle valve 12 and an engine torque is decreased. Furthermore, the shift schedule of an automatic transmission 4 can be changed to this TCS correspondence shift schedule (refer to "a A/T gear change demand" in drawing 2), driving wheel torque can be controlled synthetically, and the amount of slips (the amount of wheel spin) can be decreased.

[0076] Thereby, an effect [like] can be demonstrated in the case of the aforementioned Table 1 right column (c2). (c1) That is, since it is controlled in the direction in which a shift up becomes is easy to be performed by the accelerator quantity opening side as TCS correspondence in the auto rise of a D range, a shift up can be carried out at an early stage from a normal shift schedule, and a shift shock is small. Therefore, a slip can plan a stable disposition top by smallness also on the low μ way where TCS control operates. And also about the shift conclusion time T , like the time of the aforementioned step S121, as a result of applying the longer shift conclusion time T_A which is applied in the case of a D range as it is, the operation same with having mentioned above is obtained, since shift conclusion time is as long as Time T_A , a low μ way or slip generating serves as smallness by smallness, and a shift shock can also plan a stable disposition top also at this point again.

[0077] When the aforementioned step S103 is performed, it is made to be used together in processing by Step S104 in this example program (Step S103→S104→S105). What suppresses the elutriation peak of the slash portion of drawing 6 by lengthening shift conclusion time T at Step S103, that is, although the size of the area by the alternate long and short dash line portion

of the long D range of the shift conclusion time T and the area of the slash portion by the solid line is the same (the size of the kinetic energy of a conclusion moment — parenchyma — the same) In the case of the wave of the long alternate long and short dash line of the shift conclusion time T, the peak is suppressed, and, thereby, it is a drawing thing about prevention of slip generating by part for driving torque change.

[0078] On the other hand, when the case where a shift schedule is made to shift to a low vehicle speed side in an accelerator quantity opening side like a TCS correspondence shift schedule like the dashed line of drawing 4 step S104 illustration is seen, this will make small the size of the above-mentioned area itself, therefore the kinetic energy of a conclusion moment itself. That is, that with which a conclusion side friction element will be concluded in the state where an engine speed Ne is more high if it is the case of the normal schedule of a solid line will be concluded in the state of the low of an engine speed Ne. for this reason, torque change which the direction which has changed gears in the state where it is smaller than the case where the kinetic energy when concluding is large (torque change is large) generates — small (therefore, a shift shock smallness) — a result — what has a slip small also on a low mu way (a hardened snow way, freeze way) — becoming .

[0079] In this way, shift schedule change acts so that the area (the kinetic energy itself) of the torque wave at the time of gear change itself may be made small. Since make energy of the portion concerning conclusion small, a shift up is carried out while it is small, and it is [TCS control] under operation and it is easy to slide, the high-speed stage (high-speed gear) is made to shift one by one more early, and ** and a thing can be made to do torque. Therefore, when suppression of integration-driving torque with such gear change control will act in the suppression and this direction of slip generating by part for driving torque change and a result and also this are considered, it will become more effective and will have the efficiency nature of the engine output control for slip suppression raised. [by the above-mentioned shift conclusion time control] When doing in this way, the problem [like] (c1) in the case of the example of comparison of the aforementioned Table 1 left column can also be solved.

[0080] Moreover, if a shift schedule is made into the property made to shift to a high vehicle speed side in an accelerator low opening side as a TCS correspondence shift schedule, the still more nearly following advantages will be acquired. Generally, when slipping, it becomes easy to carry out a shift up (when it slips and wheel speed goes up, it becomes easy to cross a shift line). If TCS control is an engine output control and the shift up is the 1st speed → 2nd speed, the 2nd speed → 3rd speed, etc. one by one by this example here, although the torque itself will become small, the wheel speed (wheel rotational frequency) of driving wheels 2L and 2R becomes large. If an engine speed Ne is the same, as a result of a reduction gear ratio's (change gear ratio's) becoming so small, it is applied to calculation of a slip state and the speed of drive wheel serves as an inclination which becomes large.

[0081] Therefore, in this example program, it will carry out in the small field of the accelerator ** dull opening Ap that it is hard to carry out a shift up as possible, and a shift line is formed towards delay-izing to a normal schedule that the speed of drive wheel becomes large like the dashed line of drawing 4 step S104 illustration in order it is hard to carry out a shift up and to carry out, in order to avoid. if it carries out like this, the shift conclusion time T becomes long as mentioned above, and since the schedule itself is the direction made to delay-ize, it remains in the more nearly present gear position at M mode — having — being easy — (the appearance of gear change itself is suppressed), and a result, a slip can be suppressed more by this, and such processing can also be considered and carried out like this example program if it is made above — the time of the acceleration slip by M mode — a usual range — the same — operation of a driver — it will not be based on how, but gear change control will be performed, unlike the usual shift schedule, this gear change control is performed by having the shift schedule of exclusive use, and things are made, and even if it uses together processing of such a step S104, you may carry out

[0082] Moreover, at this example program, when step S101 → S110 → S131 are chosen, at Step S131, the processing which makes shift conclusion time T gradually the shift conclusion time TB (lower limit) is incorporated. If it does in this way, where the shift conclusion time T is once

changed for a long time at Step S103 [when Step S110 side is chosen by Step S101 and it switches] When M mode selection was still performed and it is judged at Step S110, in processing of Step S131, the shift conclusion time T can be returned gradually at the shorter shift conclusion time TB (steady-state value), and this control can be carried out in this way, and can also be carried out.

[0083] In addition, this invention is not limited to the gestalt of the above operation. For example, although the engine output control according to the slip state for TCS control is based on control of throttle control which was mentioned above, F/C, retard, charge pressure, etc., it may be based on 1 or 2 or more, and it can be carried out in such a mode. Moreover, you may add brake control to it. In this case, the fluid-pressure control actuator of drawing 1 can be constituted as a thing of a function which performs TCS by brake control.

[0084] Moreover, it is not restricted to what also showed the composition of the operating set of drawing 3 in this drawing, but the thing in the case of the ability to choose a driver can carry out automatic gear change and manual gear change similarly by other composition and modes like the reference 1 aforementioned publication.

[0085] Moreover, as for this invention, the mode which does not contain this can also carry out change processing (drawing 4 step S104) to a TCS correspondence shift schedule from a normal shift schedule. Moreover, even when this is included, it can also carry out in either the mode controlled by the accelerator quantity opening side in the direction in which a shift up becomes is easy to be performed, or the mode controlled by the accelerator low opening side in the direction in which a shift up becomes is hard to be performed.

[0086] Moreover, although the change gear with selectable gear change in hand control besides automatic gear change has been explained as an automatic transmission, this content of control is not restricted to an automatic transmission, and is good also as a nonstep variable speed gear (CVT with M mode). Moreover, this invention can aim at acceleration disposition superiors, and can also carry them out in the vehicles carrying the automatic transmission or nonstep variable speed gear which has manual mode or two range which have shortened and set up gear change time to a usual range.

[Translation done.]